Microsatellites

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11 August 1999

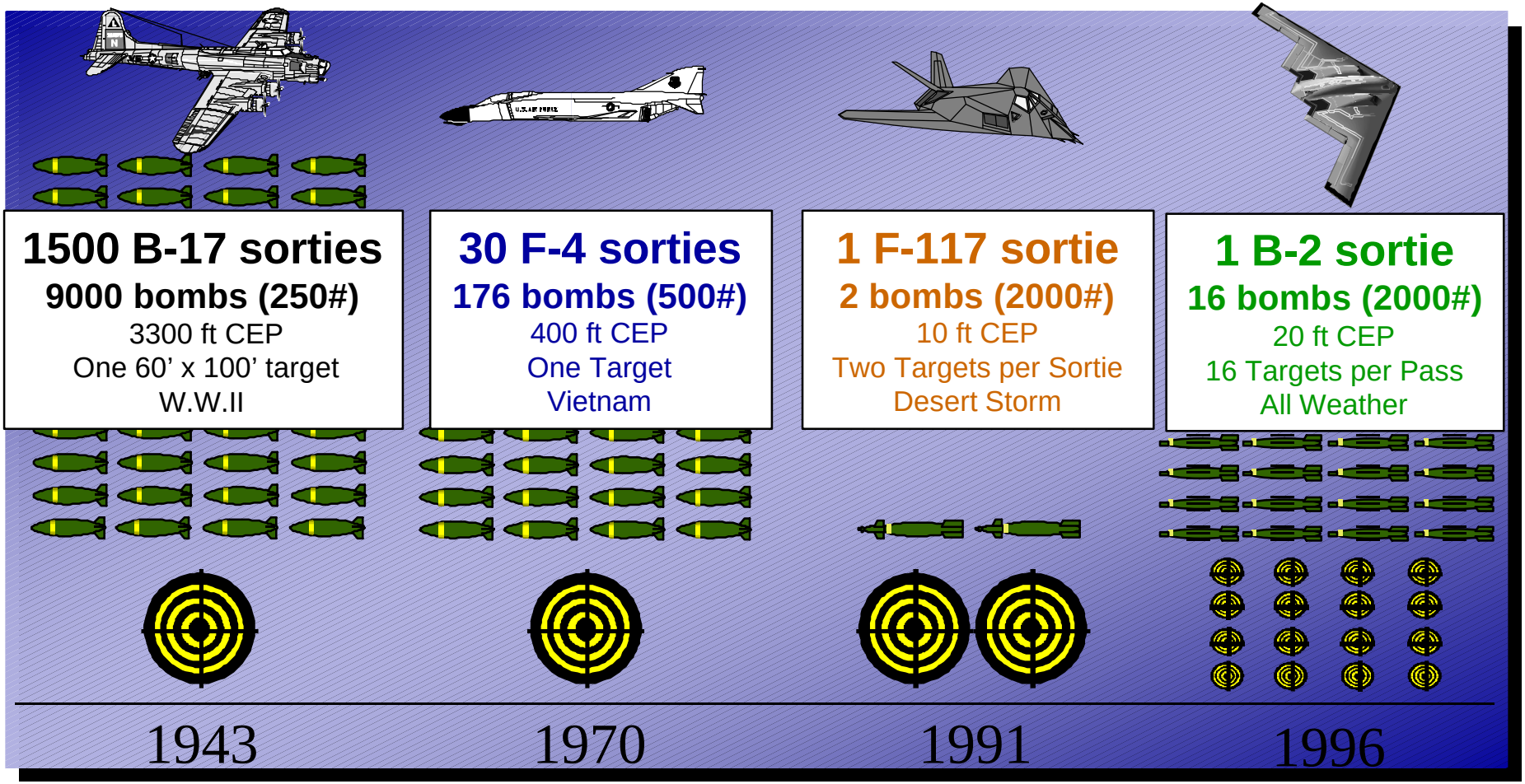
Theme

- There are new and exciting horizons in the space enterprise
  - new paradigms are forming
  - new distributions of major players
  - new frontiers in space systems and technologies
    - Driven by advances in manufacturing, lasers, microelectronics and microsystems
- Revolutionary changes in space capabilities for the Air Force are possible
  - Driven in part by microsatellites

Why Space is Important to Us ?

- Space is important for what it can do for us on the Earth
- Virtually every element of modern warfare utilizes space
  - Communications
  - Intelligence
  - Early warning
  - Weather forecasting
  - Navigation

Precision Engagement



SPACE IS AN ENABLER OF PRECISION ENGAGEMENT

Revolution

- The promise of microsatellites
  - Air Force
  - NASA
- Microelectronics combined with MEMS combined with new manufacturing paradigms
  - New capabilities
- There is parallel work in intelligent synthesis environments to give new design possibilities

The Promise of Microsatellites

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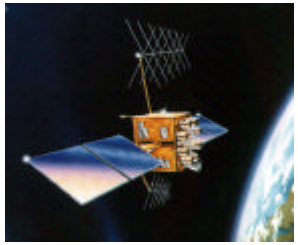
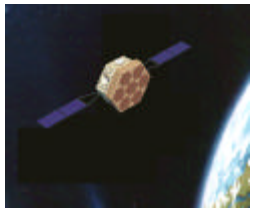
Capable Micro-Satellites (10-100kg)

Same mission with smaller, lighter satellite

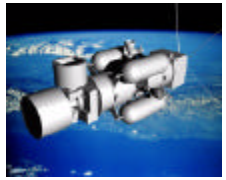


GPS IIR
970 kg (dry)

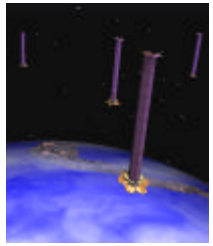


micro-GPS
<100 kg

New missions enabled



Logistics/
Control



Satellite
Clusters

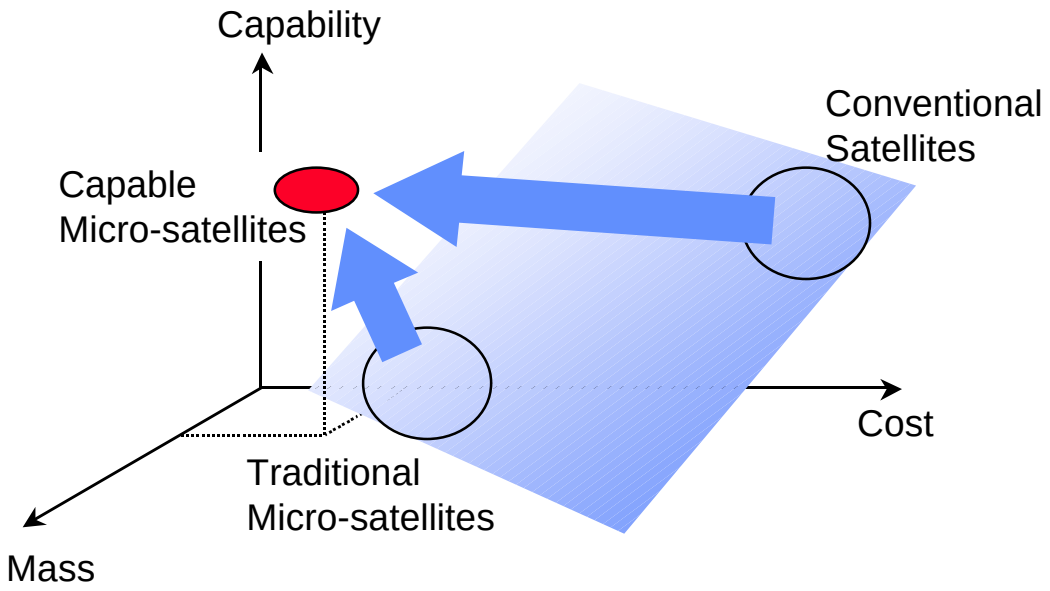
Tactical
Space

Micro-Satellites Bring Affordable New Capabilities to Revolutionize Space Missions

Next-Generation Micro-Satellites

- Technology-driven, order-of-magnitude, cost/weight reduction over traditional satellites of the ***same performance***

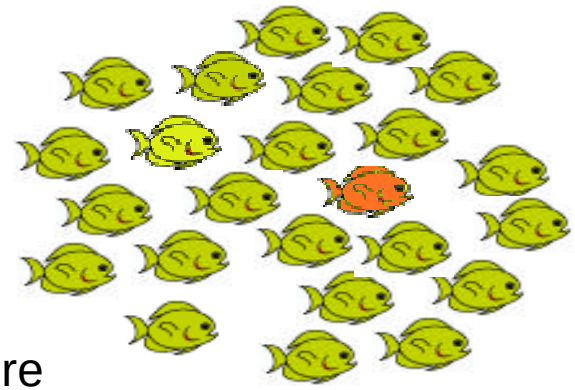
Micro Satellite <100kg
Nano Satellite <10kg



Next generation micro-satellites rival existing satellite capabilities

Benefits of Satellite Clusters

- Reduced life cycle cost
  - Mass produced identical satellites reduce manufacturing cost
  - Low mass/volume permits rides of opportunity, reduces launch cost
- Better performance
  - Unlimited effective aperture sizes
  - Multi-mission capability
- Improved reliability
  - Graceful degradation
  - Reconfigurable to minimize effects of failure

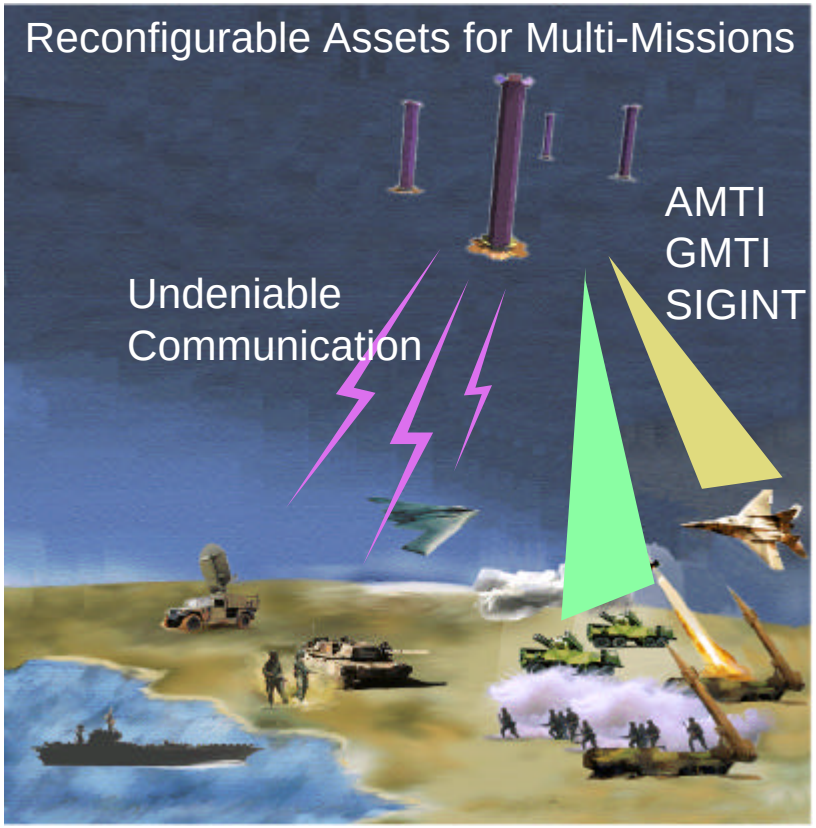


- Inherent adaptability
  - Add new elements to accommodate changes in requirements
  - Future technology advances integrated in a cost effective manner

A Vision for Next Generation Space Systems

TechSat 21 is a revolutionary micro-satellite program involving:

- Basic rethinking of space system architectures
- Simultaneous attack on performance *and* cost
- New paradigms to change the order of business for Air Force



Goal: Affordable, Real-time, On-demand Global Awareness

Collaborating Microsatellite Clusters -TechSat 21

- Explores a New Paradigm for Satellite Functionality
- Cluster of formation flying capable microsats form a “virtual satellite”
- Concept enables multi-mission capability
  - Space Based Radar
  - Communications
  - Passive radiometry

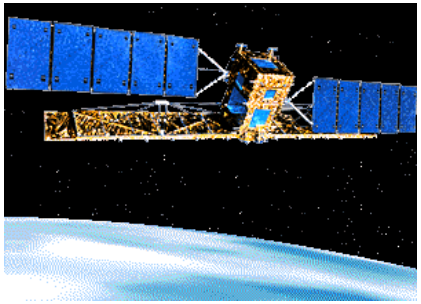
A Multi-Directorate AFRL Initiative Led by Space Vehicles Directorate and AFOSR

Identified by New World Vistas Space Technology Panel as the revolutionary concept that leads to new paradigms for space applications

TechSat 21:
Space Based Radar Application

Conventional

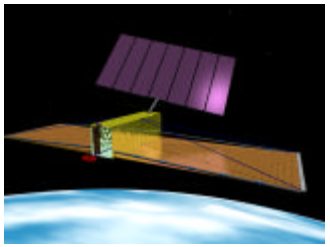
Rigid Panel Deployable



- 12,000 Kg
- 1996 Tech Freeze Date
- Titan IV Launch
- 40 satellites

Evolutionary

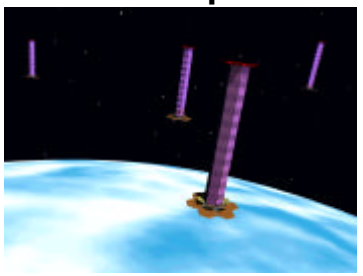
Integrated Antenna



- 4,400 Kg
- 2003 Tech Freeze Date
- Atlas II Launch
- 40 satellites

Revolutionary

Distributed Spacecraft



- Eight 100 Kg satellites per cluster
- 2005 Tech Freeze Date
- Taurus/Athena II Launch
- 40 satellite clusters

System Cost (10 year life cycle, normalized)

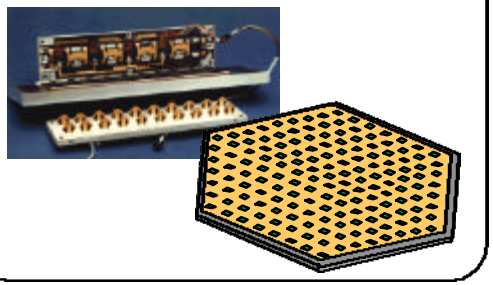
1.0 → 0.6 → 0.3

1/3 the Cost of Today's Systems and 3X the Capability

Micro-Satellite Technology for Macro-Capability

THIN FILM PHOTOVOLTAICS

TRANSMIT/RECEIVE ANTENNA MODULE (TRAM)

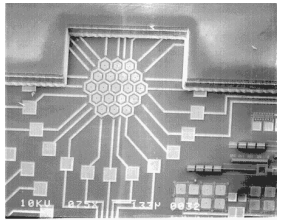


SMART MECHANISMS

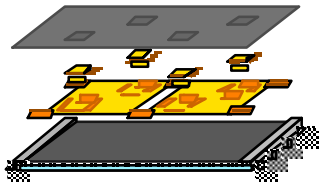
SMA GIMBAL

SMA HINGE

MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)

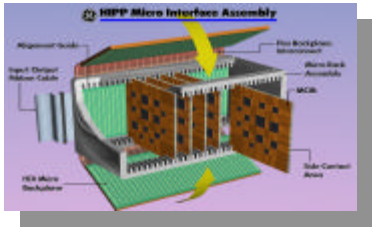


MULTIFUNCTIONAL STRUCTURES



Highly capable micro-satellites <100 Kg

ADVANCED PROCESSORS AND ELECTRONICS PACKAGING



Leverages Breakthroughs in Commercial Technologies

Summary

- Future World:
  - Many widely available commercial space services
  - Commercial space spending dwarfs government spending
- Much intellectual vitality & new warfighting capabilities associated with new space enterprise
  - New paradigms
    - Growth of commercial world driven by market oriented information services
    - Design & manufacturing changing from craft to custom lean
  - Evolution
    - Integrated ISR systems (space based radar ….)
    - Global Energy Projection (large optics in space..)
  - Revolution
    - Microsatellites (clusters and constellations) driven by microelectronics and microsystems